UTAH—RESOURCES AND ACTIVITIES

Supplement to the

UTAH STATE COURSES OF STUDY

For

ELEMENTARY AND SECONDARY SCHOOLS

DEPARTMENT OF PUBLIC INSTRUCTION

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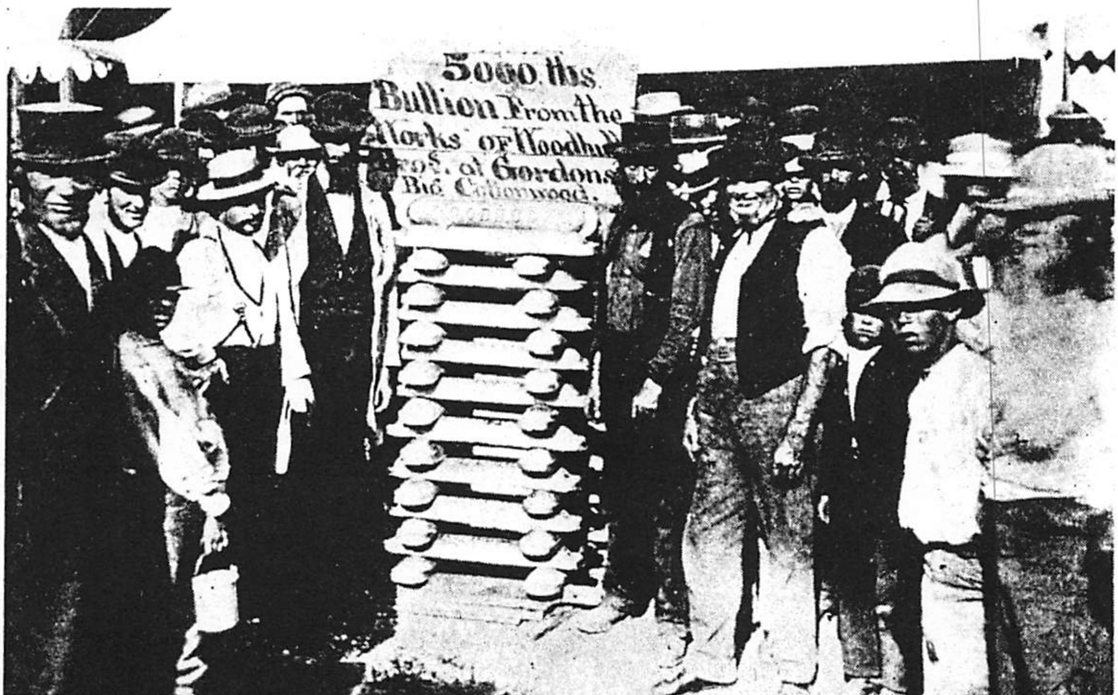
CHAPTER XVII

MINING AND MINERAL WEALTH

Mining in Utah

Historical.[1] Utah was settled in 1847. By 1852 coal, iron, and non-ferrous deposits had been discovered and produced in sufficient quantities for local needs. However, the mining industry of Utah of today had its inception in the chance discovery, by a soldier prospector, George B. Oglivie, this discovery was made in 1863 in the district which is now known as Bingham.



Courtesy Utah Photo Materials Co.

FIGURE 97—One of the first shipments of bullion from Big Cottonwood Canyon.

The growth of Utah's mining industry has been slow but steady. As was to be expected, at first every outcrop was looked upon as a bonanza and prospectors felt sure they would soon be millionaires. Beginning with that September day, in 1863 when the first mining claim located in the State of Utah was staked out and christened the "Jordan" by Oglivie and his comrades, the mines of Utah have produced, up to January 1, 1929, gold, silver, copper, lead, and zinc in value, $1,610,514,947 and have yielded $312,842,664 in dividends.

As has been true of the development of most of the great mining districts of this country, Utah owes the development of its mining industry to a group of remarkable characters, outstanding among whom was General Connor, brilliant soldier and veteran Indian fighter, who was in command of the United States troops stationed in Utah in 1863, and who has been honored by later generations as "The Father of Utah Mining."

[1]Anyone desiring further information concerning the history of mining in Utah may obtain the same by addressing the Secretary of the Mining Committee of the Chamber of Commerce, Salt Lake City, Utah.

Today the mineral resources of Utah have been developed to a point which places it among the three or four most important metal mining states in the Union. Such a ranking in a state of only 507,847 population indicates that its mining industry is a vital element in its economic life. In fact, the mining industry employs about one-third of the total number of employees carried by the State Industrial Commission, produces about one-third of the new wealth annually created in the state, and supplies four-fifths of all the railroad tonnage of Utah.

The economic importance of mining in Utah. In actual figures, the output of Utah's mines is valued at about $120,000,000 annually.[1] Of this gross value, approximately $85,000,000 is immediately expended, largely within the state, for wages, freight, smelting, and supplies. Thirty million dollars of this is spent for labor at mines and smelters. The stockholders of the mining companies received, in 1929, approximately $38,167,318 in dividends, which was the largest dividend ever paid in the history of the state. The mining industry is, indeed, therefore, a very important factor in Utah's present economic structure. The mining industry provides employment directly for approximately 17,000 persons resident in the state. The economic and social welfare of these men and their families is dependent upon mining and industries directly built upon it. A survey of some of the mining towns seems to indicate that the national figure on size of family holds good for these particular towns. If it holds true that for every wage earner 4.3 persons obtain their livelihood, it means that about 70,000 persons are directly dependent upon the mining industry for a living. When we add to this number those indirectly dependent upon the industry, it brings the number considerably higher. This, of course, refers to the tradespeople, for almost all of the enormous annual payroll of twenty-eight and a half million dollars finds its way into the channels of trade.

There are, however, others besides the tradespeople who are indirectly dependent upon this industry. The mining industry is the largest consumer of electrical power in the state, and the electrical industry employs a considerable number of persons. Likewise, the mines, through their products, furnish the railroads a very large part of the intrastate traffic, and the railroads in turn employ hundreds of men to handle this freight. Mining is, therefore, one of the very foundation industries of the state. The summary below indicates Utah's importance as a mining state:

TABLE 66

SHOWING UTAH'S IMPORTANCE AS A MINING STATE

	Average Annual Production 1925-1929	Proportion U. S. Total	Rank in U. S.
Gold	1,007,454 oz.	8.86%	5th
Silver	93,907,468 oz.	30.51%	1st
Copper	1,394,426,495 lbs.	15.63%	2nd
Lead	1,495,094,000 lbs.	22.59%	2nd
Zinc	443,856,000 lbs.	6.12%	5th

1 What Mining Means to Utah—Publication of the Chamber of Commerce of Salt Lake City, Utah.

Mining Districts[1, 2]

Utah has three principal mining districts, namely, the Bingham District, the Park City District, and the Tintic District. From time to time several other districts of the state have been important producers, as for example:

The Frisco District in Beaver County. The principal mine is the Horn Silver Mine which has to its credit a total production of $50,000,000 from a block of ground 1000 feet long, 400 feet wide and 1000 feet deep.

The Alta District[3] in Salt Lake County. The principal producing mines were the Prince of Wales, the City Rocks, the Grizzly, the Flagstaff, and the Emma, which, in their day, were producers of bonanza rock, and in recent years the Cardiff, which has paid out approximately $1,075,000 in dividends. Twenty-four separate companies previously operating in the Alta District have been merged into one company known as the Alta Merger Mines Company. There has been produced to date from property now owned by the Alta Merger Mines Company more than $4,000,000 worth of silver, lead, copper, and gold ores.

The Silver Reef in Washington County, which was discovered in 1874, has been termed one of the most famous ghost camps of the West, and has to its credit a production of $7,897,142.

Other districts which have, in the past, been producers are the Gold Hill, West Tintic, Marysvale, Ophir, and Box Elder and Grand counties.

BINGHAM[4]

History. The first mining claim to be located in the state was staked out in this district on September 17, 1863 by Oglivie and his companions and christened the "Jordan." Three months later to a day, the West District was organized. The following year placer gold was found in Bingham Canyon and the now famous copper district began life as a gold camp. Lack of transportation facilities and reduction plants handicapped development so that the original discoverers profited little by their luck. As distances to railroad and smelter became reduced by the slow advance of the outposts of civilization, the output of silver-lead mines was increased.

Location. The Bingham District is in Salt Lake County and is located about 27 miles from Salt Lake City in a southwesterly direction. There are two railroads into the district, the Denver & Rio Grande Western and Bingham & Garfield, the latter being the property of the Utah Copper Company and used by the company in delivering the ore from its mines to its concentrating plants at Magna and Arthur. The Bingham Stage Lines also operate between Salt Lake City and Bingham Canyon, with frequent service.

1 Mining Districts and Their Relation to Structural Geology, by J. J. Beeson. Transactions of American Institute of Mining and Metallurgical Engineers, No. 1500-I.

2 Mineral Resources of United States, by U. S. Bureau of Mines.

3 Geology of Cottonwood District, Utah, by B. S. Butler, G. F. Loughlin and V. C. Heikes, U. S. G. S. Bulletin No. 620-I.

4 Those interested in the geology of the district and in its ore deposits are referred to U. S. G. S. Professional Paper No. 111, in which is contained a bibliography of the Bingham and other districts of the State.

Geology.[1] The geologic section in the Bingham Canyon is thick, with a synclina structure, but only the upper carboniferous beds contain the ores which are mined at present. These beds are from 12,000 to 15,000 feet thick. The largest member, the Bingham quartzite, includes several beds of limestone, which have a total thickness of about 300 feet. A quartz monzonite porphyry has been injected into the beds, altering them considerably, especially the limestone members. The porphyry, which forms a stock, is strongly fissured and fractured.

The ore deposits of the Bingham Canyon District were formed by hot solutions originating within the magma that gave rise to the quartz monzonite porphyry. The first period of mineralization occured shortly after the intrusion of the porphyry and formed the contact-metamorphic and replacement deposits in the limestones. In the latter, excellent copper-gold-silver and lead-silver-zinc ore occur as veins and as replacements. The former contain pyrite, chalcopyrite. and more rarely chalcocite and bornite. The latter deposits contain argentiferous galena, pyrite, sphalerite and some chalcopyrite. By means of flotation these intimately associated minerals are separated into three or more salable products.

The second period of primary deposition took place largely in the fissure porphyry and quartzite. It was during this period that the primary disseminated deposits were formed. Quartz, chalcopyrite, pyrite, bornite and occasional veinlets of molybdenite are the chief primary minerals. Following exposure by erosion, most of the copper was leached out of the upper part of the deposits and was redeposited lower down as chalcocite and covellite. The copper provided by this secondary enrichment, when added to that already present through primary mineralization, allows the profitable mining of the porphyry ore by the large scale methods employed by the Utah Copper Company.

Mines in the district. Among the mines which produce principally silver, lead, and zinc are the United States, the Utah Apex, the Utah Delaware, the Utah Metal and Tunnel, Bingham Mines, and the Bingham Prospect. The Utah Apex is the deepest mining operation in the state. The lowest workings are over 4000 feet in vertical depth and the lowest level, the 3100, is reached by an inside underground shaft which extends below the 2400 foot level.

The Utah Copper Company. The Utah Copper Company is one of the large copper mines of the world. During 1929 the mines of this company produced 306,527,513 pounds of copper, yet it has many years of activity ahead of it, as indicated by the fact that during 1929 an aggregate of 5075 feet of churn drilling developed additional positive ore amounting to 15,000,000 tons with an average grade of 1.12% copper. Indications are that the probable ore will amount to an additional 20,000,000 tons with a grade of about 1% copper. The total ore reserves as of December 31, 1929, as they will be mined amount to approximately 640,000,000 tons averaging 1.07% copper. To date there have been mined 193,868,751 tons. Drilling operations will continue for several years with assurance that additional ore will be developed.

1 These paragraphs on the geology of the principal mining districts have been adapted from "Introductory Economic Geology," by W. A. Tarr; McGraw-Hill Book Co., I.

In the year 1927, as in the year 1926, the Utah Copper Company held the ranking position of all companies from a standpoint of production. In 1927, it produced 90.7% of all the copper mined in the state. In the year 1928 this company produced about 15% of the United States total, and since the United States, during that year, produced 55% of the world's refined copper, it can safely be stated that in 1928 this company's output represented about one-twelfth of world production.

During 1929 a record production of 17,724,100 dry tons of ore were mined and transported to concentrating mills, this being an increase of 1,165,600 tons over the 1928 tonnage.

FIGURE 98—The Utah Copper Mine at Bingham, 27 miles southwest fro

The total amount of ore treated at the concentrating mills at Garfield was $17,724,100 dry tons, about equally divided between the Arthur and Magna plants. This is equivalent to 50,210 tons per day for the 353 operating days in the year. The average copper content of this ore was about 19.89 pounds per ton.

During the year 1929 the electrification of the mine haulage system was continued by the addition of thirty electric locomotives of 85 tons each, making a total of forty-one now in service. To furnish power for the additional locomotives, eight 1000-kilowatt rotary converters with the necessary transformers and switching apparatus were installed.

The Ohio Copper Company. Another producer of copper in the Bingham District is the Ohio Copper Company of Utah which, after several years of unprofitable mining and milling of its low grade copper ores, adopted, in 1923, leaching and precipitation as the method of extracting the copper and which still is being successfully carried on. This system consists of dis-

tributing a slightly acidified solution over the surface of the old stopes containing a large tonnage of low grade ore through which it percolates and becomes enriched with copper. The copper solution is then collected in the Mascott Tunnell 1100 feet below the surface where it is conducted through launders containing light scrap iron. The copper carried in solution replaces the iron forming a high grade cement copper or copper mud which is shipped to the Garfield plant of the American Smelting, Refining and Mining Company.

For the past two years extensive exploration work has been carried on in the limestone deposits underlying the property at depth below the Mascott

Courtesy Utah Copper Company.

alt Lake City. The largest open copper mine in the world.

Tunnel, with a view to developing the copper-gold and lead-silver ores known to exist under similar conditions in adjoining properties.

PARK CITY[1]

History. Sporadic atempts to mine in Park City date back as far as the Walker and Webster Claim in 1869. Real mining activity began with the discovery of the Ontario by Rector Steen, a soldier prospector of mining experience in California who had enlisted for service in Utah because the mountainous character of the country led him to believe that minerals could be found in the territory. Steen did considerable prospecting with but little success. But on June 15, 1872, he happened to see a knob of ore projecting up out of the ground. An assay proved the rock to carry from 100 to 400

1 Geology and Ore Deposits of Park City District, Utah, by J. M. Boutwell and others, U. S. G. S. Professional Paper No. 77.

ounces of silver to the top. Steen staked out the Ontario and began mining the ore body which was to produce over $50,000,000 in silver, lead, and gold. Other great mines were then opened up and Park City soon assumed a position as one of the leading mining camps of the west.

Location. The Park City District is in Summit County and is located about thirty miles east of Salt Lake City. Both the Denver & Rio Grande Western and the Union Pacific railroads operate trains into the district, which haul the rich ores out. Stage lines also run between Salt Lake City and Park City furnishing regular passenger transportation.

Ores. The ores of the Park City District occur as lode and as bedded deposits in sedimentary and intrusive country rocks. The two types of deposits are commonly associated throughout the region, though some lodes and veins occur alone. The lode deposits are extensive, strong, and valuable. They lie in a few continuous master fault zones, rather than in a large number of small fissures. These deposits may be characterized as argentiferous lead ores with some zinc and copper and a small amount of gold. The lead occurs as carbonates and oxides in the upper levels and as sulphides in the lower portions. The silver is associated with tetrahedrite and galena. Lode ore of economic size and grade extends from the surface to depths of more than 2000 feet. In general the upper parts of these deposits have proved richest, the middle section has been of high grade, and the deeper portions larger but leaner.

Mines in district. The leading producing mines of the Park City District are the Silver King Coalition Mines Company, Park Utah Consolidated Mines Company, the New Quincy Mining Company, and Park City Consolidated Mining Company.

Silver King Coalition Mines Company. The property of the Silver King Coalition Mines Company, and of its predecessors has been under constant development since 1882, and now consists of nearly 4000 acres of mineral-bearing land. Since that date to 1930 it has produced gold, silver, copper, lead, and zinc of a gross value of $90,746,140. These metals were obtained from 1,677,724 tons of ore. From this total there has been expended for wages, supplies, materials, taxes, freight, treatment, and other necessary costs, the sum of $60,979,088 all of which has gone into the channels of industry. The company employs about 725 men.

Park Utah Consolidated Mines Company. The properties which now constitute the Park Utah Consolidated Mines Company have been under constant development since 1872, at which time the Ontario-Daly lode system was first discovered. At that time the ore from the tunnel which was started from the bottom of the canyon averaged $250 per ton. From 1872 to December, 1876 the property yielded $1,100,000.

When the Ontario property began to show its great value the claims immediately to the west were taken up by J. J. Daly. In February, 1885 the Daly Mining Company was formed. The organization of the Ontario and Daly companies has been in part identical, and they have conducted their operations in conjunction.

The properties of the company are fully equipped to handle approximately 1000 tons of ore per day. The underground workings are tapped by three main transportation and drainage tunnels and five deep shafts. During 1929 the lowest level was extended from 1800 to the 1940 level in the search for the continuation of the ore bodies above. On the 1800-foot level the headings are being advanced in entirely new territory under conditions which give excellent promise of new discoveries of importance. In 1929 what is known as the city unit of the property produced 123,939 tons of ore, and its large underground territory continues to give every assurance of many years of major production.

In 1929 the company mined 300,931 tons of ore, containing 48,708,381 pounds of zinc, 40,784,284 pounds of lead, 1,229,051 pounds of copper, 25,387 ounces of gold, and 2,759,678 ounces of silver.

New Quincy Mining Company. The New Quincy Mine is located about two and one-half or three miles south of Park City in the Uintah and Snake Creek mining districts, part of the property being in Summit County and part in Wasatch County.

The property consists of 337.75 acres of patented ground located in the Park City formation along a strong fissure system. The property produced, during the year 1928-1929, some 49,580 tons of silver-lead-zinc bearing ore which had an average assay value of lead, 12.05%; copper, 11.7%; zinc, 15.1%; silver, 23.24 oz.; gold, .0315 oz.

Park City Consolidated Mining Company. Up to 1929 the part of the district in which this company is operating was not looked upon very favorably by engineers and geologists, but through the energies of geologists who maintained that the scope of the Park City District was not alone confined to Park City proper, the existence of bodies of rich silver and lead ore has been shown, and while the figures of shipments are not available, production has been satisfactory. In other parts of the Park City District, outside of the proven territory, development work is being carried on.

TINTIC[1]

History. Although the Tintic District began production modestly with little excitement attending the first discovery, it has now developed into one of the greatest silver districts in America. Government records merely report that Steve Moore, a prospector, located the first claim, the Sunbeam, in 1870. History's seeming indifference to the importance of Moore's disclosure is easily explained. At the same time Moore made his important discovery in the Tintic District, strikes were the order of the day. Exciting discoveries were being reported from Alta, Park City, Bingham, Beaver County, Ophir, Silver Reef, and other places, which have long since been forgotten.

Consequently, slow but steady growth characterized the development of this district. A month after Steve Moore had located the Sunbeam, two of the district's richest mines, the Eureka Hill and the Mammoth, were staked and by 1871 the camps of Silver City and Diamond, at the south end of the district, sprang up as a result of the discovery of rich ores in the porphyry.

1 Notes of the Geology of East Tintic, by G. W. Crane. Transactions of American Institute of Mining and Metallurgical Engineers, No. 1491-I.

Development of the limestone followed somewhat slowly. As a matter of fact, the pioneers of Tintic activity thought so little of the limestone deposits, it is related that the Mammoth Mine, later a producer of $20,000,000 was traded for a herd of Texas cattle.

The building of a railroad into the district in 1878 stimulated activity, and one rich discovery after another was made. As time went on, the Eureka Hill, the Humbug, the Spy, the Centennial Eureka, the Gemini, the Swansea, the Godiva, the Sioux, the Iron Blossom, the Colorado Chief Consolidated, and others poured forth a stream of rich ore.

Location. The Tintic District is located in Juab County about 90 miles south of Salt Lake City. Lines of the Union Pacific and the Denver & Rio Grande railroads run into the district and stages furnish regular passenger service to and from various points in the district.

Metals and minerals. The ore metals include silver, gold, lead, zinc, and copper. Much iron ore has been, and is being mined from the south end of the district and shipped to the smelters as flux. Also the Chief Consolidated Mining Company has several million tons of very pure limestone on its holdings which assay around 98% calcium carbonate which is being shipped to the smelters, sugar factories, and as burnt lime to the mills, etc.

Geology. The rocks of the area are strongly folded and faulted Paleozoic sediments. They consist of 6,000 feet of the Tintic Quartzite, below 6,500 to 7,000 feet of limestone and dolomite with some shale. In Tertiary times, lavas spread far and wide over the area, and later a small mass of monzonite was intruded into the earlier rocks.

The mineralizing solution that formed the ores evidently came from the deeper portion of the monzonite intrusive. The solutions were only moderately hot (100° to 300°C), and the deposits were formed at distances between 1,500 and 3,000 feet of the surface. Two phases of mineralization occurred. The first consisted in the replacements of limestone and dolomite by colloidal silica that slowly crystallized as chalcedony or jasperoid. Barite, pyrite, galena, and other minerals were formed also. The minerals of the second phase were deposited in irregular openings within the jasperoid, and consist of more barite and large quantities of galena and other ore minerals.

The ores occur in both the igneous and sedimentary rocks, but are far more abundant in the sediments. The deposits in the igneous rocks are fissure veins containing pyrite, enargite, and a little galena and sphalerite, together with the typical gangue minerals, chalcedony, quartz, and barite. The ore in the sedimentary rocks occurs as replacement bodies having a wide range in size and shape. One has been mined continuously for 7,000 feet and can be traced for an additional 4,000 feet. Another has been mined for 8,000 feet horizontally and at one end for over 1,000 feet vertically. The thickness varies from 4 to 50 feet. Primary ore minerals are galena, pyrite, enargite, and sphalerite; those in the 2,000-foot oxidized zone are argentite, cerargyrite, native silver, cerussite, and anglesite. Important ore bodies containing native gold as the chief value have been mined at the Mammoth, Centennial, Eureka, Eureka Standard, North Lily, and other mines. The Dragon Mine of this district also has a large deposit of non-plastic kaolin, which is of excellent grade.

Mines. The leading producers of the Tintic District are the Tintic Standard Mining Company, North Lily Mining Company, Chief Consolidated Mining Company.

Tintic Standard Mining Company. From 1917 to December 31, 1929, the Tintic Standard Mine produced 27,693 ounces of gold, 35,937,932 ounces of silver, 361,553,421 pounds of lead, and 10,181,873 pounds of copper, and has paid dividends amounting to $12,787,247. This company alone produces approximately 10,000 tons of ore per month. From a prospect with only a few thousand feet of workings, the Tintic Standard has developed into one of the most successful mining corporations in the United States, with more than 80 miles of underground workings and several subsidiary mines purchased and being explored to perpetuate the enterprise.

North Lily Mining Company. In 1924 the North Lily Mining Company's holdings consisted of seven undeveloped mining claims, whose only claim to merit was its proximity to the one productive mine, the Tintic Standard, in the East Tintic District. By acquiring the East Tintic Coalition Mining Company property in 1926, and several other properties since then, the North Lily has now become a very important producer, with an average production of more than 6,000 tons of ore per month.

During 1929 the East Tintic property produced 72,889 tons of dry ore. Metal production amounted to 33,168,854 pounds of lead, 492,796 pounds of zinc, 790,143 ounces of silver and 9,413 ounces of gold. The company paid dividends amounting to $795,550 in 1929.

Chief Consolidated Mining Company. The Chief Consolidated No. 1 Mine, which is the main producer of this company, has since the date of discovery in 1909, produced 1,220,255 dry tons of ore, containing 89,615 ounces of gold, 23,839,135 ounces of silver, 294,876,734 pounds of lead, 464,892 pounds of copper, and 22,049,401 pounds of zinc. The company, since its organization, has paid $3,654,519 in dividends and has acquired several subsidiary mines which are now important producers.

There are numerous producing mines in this district, including the Eureka Standard, the Eureka Lily, and others, practically all of which are controlled by the Tintic Standard, North Lily, and Chief Consolidated.

LIST OF MINING DISTRICTS IN UTAH

The following is a complete list of the mining districts of the state:

Beaver County	Beaver Lake, Bradshaw, Granite, Indian Peak, Lincoln (Jarloose), Newton, North Star, Pine Grove, Preuss (New House), Rocky, Frisco, Stra, Washington
Box Elder County	Ashbrook, Lucin, Newfoundland, Park Valley, Promontory
Cache County	Box Elder, Paradise (LaPlata)
Davis County	Farmington
Emery County	Emery (Lost Springs), San Rafael

Garfield County	Coyote Creek, White Canyon (Hite)
Grand County	Little Grand, Miners Basin, Richardson, Wilson Mesa
Iron County	Gold Springs, Iron Springs, Pinto Iron, Stateline
Juab County	Detroit (Joy), Fish Springs, Mona, Mount Nebo, Spring Creek, Tintic, West Tintic
Millard County	Leamington (Oak City)
Morgan County	Agenta (Mill Creek), Morgan
Piute County	Kimberly (Gold Mountain), Ohio (Marysvale, Gold Mountains)
Salt Lake County	Big Cottonwood, Hot Springs, Little Cottonwood (Alta), West Mountain (Bingham)
San Juan County[1]	Blue Mountains (Monticello), Bluff
Sevier County	Henry, Salina Creek
Summit County	Uintah (Park City)
Tooele County	Blue Bells, Rush Valley (Stockton), Clifton (Gold Hill), Columbia, Desert, Dugway, Erikson, Granite Mountain, Lakeside, North Tintic, Ophir, Rush Valley, Silver Islet, Tooele, Willow Springs
Uintah County	Carbonate, Green River (Club Creek)
Utah County	American Fork, Lehi, Provo, Santaquin, Silver Lake, Tintic, Utah
Washington County	Bull Valley, Harrisbury (Silver Reef), Tutsagubet
Wasatch County	Blue Ledge, North Fork, Rhodes Plateau (Woodland), Snake Creek
Weber County	Sierra Madre

Metallurgical Operations

COPPER-LEAD-ZINC

Mills and smelters. The district tributary to the Salt Lake Valley is Oregon, Idaho, Nevada, parts of California, Western Colorado, Wyoming, Montana, and Utah, thus making Salt Lake City and the adjacent valleys a leading metallurgical center. All of the plants situated in the valleys are equipped with the most modern devices for the reduction of ores.

As is well known, most of the ores which are mined today in the several mining district of Utah are too low-grade to be smelted direct. Hence, the

[1] Geologic Structure of San Juan Canyon, by Hugh D. Miser, U. S. G. S. Bulletin No. 751-d.

ores as they come from the mines must first be subjected to a concentrating process in order to separate the metal bearing content of the ores, to such an extent as it may be commercially feasible to do, from the non-metals, or gangue material. For this reason concentration processes have been more highly developed in the Salt Lake Valley. As is also well known, the flotation process is the process by which the majority of the ores mined in the state are treated in order to recover their metallic content.

Flotation process. By flotation, intimately associated minerals such as silver, lead, zinc, and copper occuring in one ore are separated for economical

Courtesy Utah Copper Company.

FIGURE 99—The Magna Concentrating Plant. Arthur Concentrating Plant in the distance.

reduction to metals by smelting. The ores treated are, for the most part, sulphide ores. However, owing to improvements in the process and as a result of research and experimentation, it is now possible to recover the metallic values from oxidized ores, as well as sulphides. Custom plants for the treatment of such ores are now operating in the district.

Applied to the complex ores of Park City and Bingham, this process recovers nearly 100,000,000 pounds of zinc that formerly went to waste and makes better recoveries of the other metals than were formerly dreamed of. In the state as a whole, flotation has increased zinc production about five times. This has brought to the mines about $6,000,000 more annual revenue, and an additional $2,540,000 in freight to the railroad companies. Mining companies have been saved $3,500,000 annually in lower smelter treatment charges by the elimination of zinc from their lead smelting ores.

But the recovery of zinc is not the only benefit flotation has given the mining industry. It has made possible better milling practice in almost all classes of ore. The Utah Copper enterprise acords an impressive example of the

application of the flotation process. Today it has one of the largest flotation plants in the world. During 1929, when operating at full capacity, this company mined on an average of 50,210 tons of ore per day. In 1905, when milling was first begun at the Utah Copper, ore below 1.2 per cent in copper could not be treated and metal recoveries were less than 65 per cent. During 1929, the average recovery in this form of concentrates was 86.67 per cent of the metal values in ore carrying .994 per cent copper, or 19.89 pounds per ton.

The Utah Copper does not operate a copper smelter, but sells the concentrates from its concentrating plants to a nearby smelter. A number of

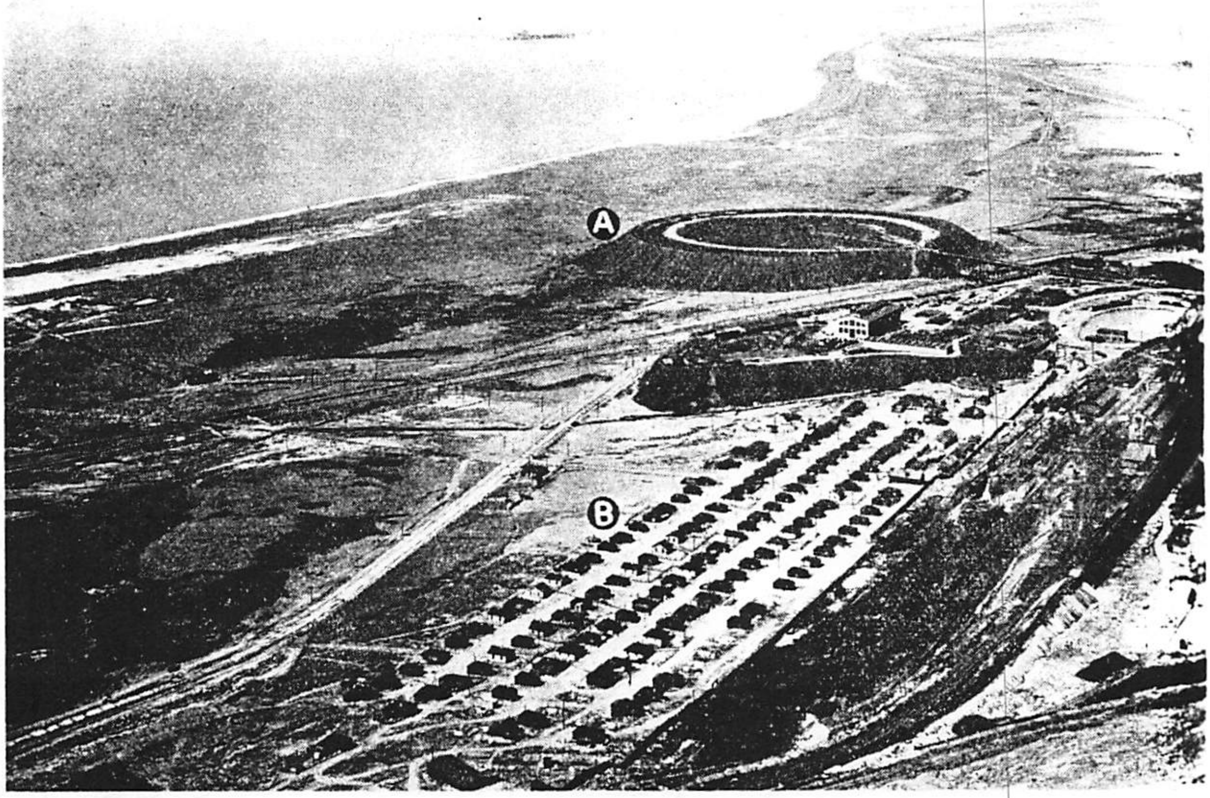


FIGURE 100—An air view of the Garfield copper smelter of the American Smelt...

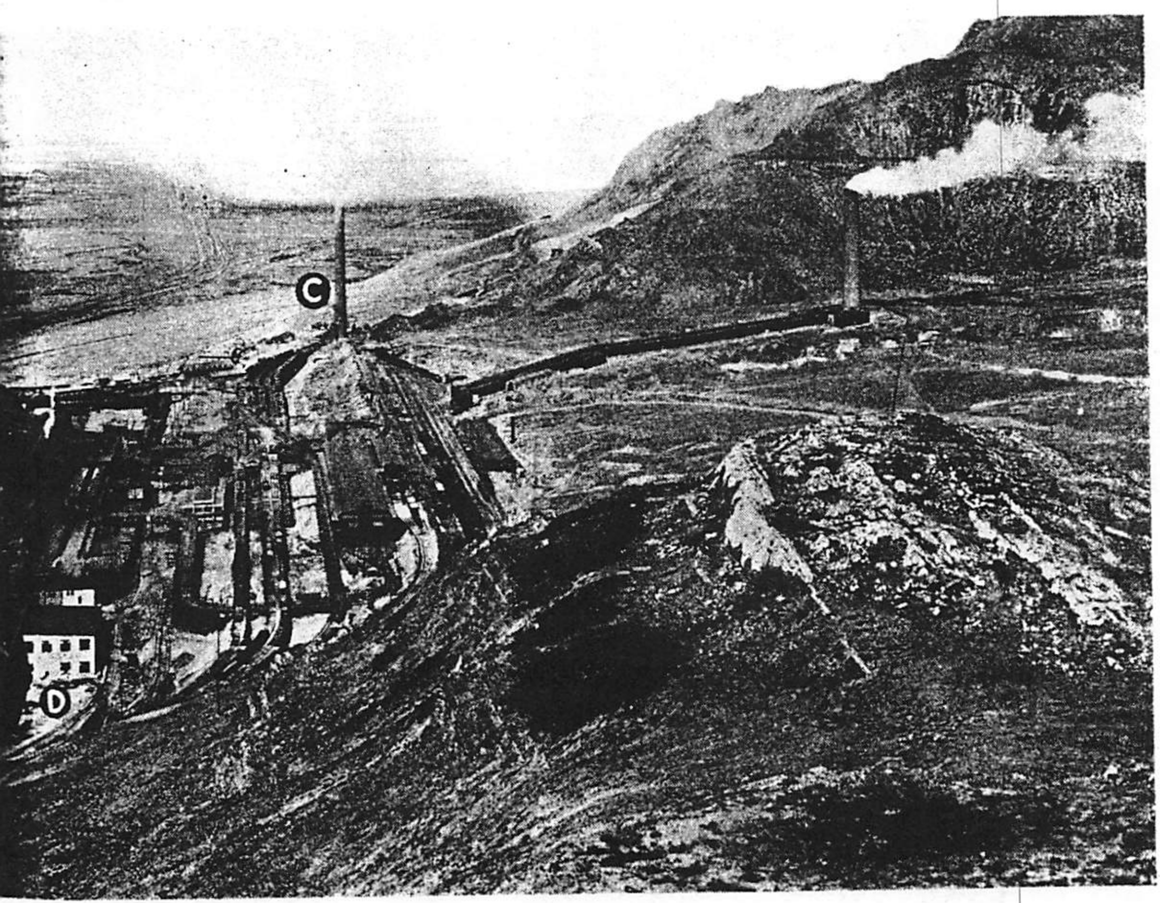
A. Slag dump.
B. Former residential district of employees and families.
C. Left stack, 350 feet high.

Utah mines also own and operate their own concentrating plants. However, as the magnitude of the operations of many of the mines of Utah does not warrant their owning and operating their own concentrating plants, the ores from such mines are sold to custom plants. The three principal custom plants being operated at the present time are those of:

The Combined Metals Reduction Company at Bauer. This company's flotation plant was built in 1924 to handle 200 tons of ore daily from the company's mine at Pioche, Nevada. The capacity of the plant was increased, in June, 1929, to 450 tons and in March of 1930 to 800 tons daily. The plant is now treating custom ores from Utah, Idaho, Nevada, and Colorado,

as well as the complex lead-zinc ore from the company's mine at Pioche, Nevada. During 1929, the flotation plant produced 1,186 ounces of gold, 628,116 ounces of silver, 13,713,328 pounds of lead, and 26,450,715 pounds of zinc, with a net smelter value of $1,569,073.17. The company employs 225 men at its mine and mill at Bauer.

The International Smelting Company. This company has erected flotation plants at Tooele in which are concentrated not only the ores from its own mines in Utah and adjacent states, but likewise custom ores from these



Refining Company. The largest copper smelter in the United States.

D. Power house, machine shop, foundry, reverberatory furnaces, converters, roasting ovens, sampling and crushing department, receiving and unloading bins, sulphuric acid plant, and railroad trackage.

states. The lead and copper concentrates from the mills at Tooele are sent to the lead and copper smelting furnaces, which are operated by the company at Tooele, while the zinc concentrates are for the most part shipped to the electrolytic zinc plant of the Anaconda Copper Mining Company located at Great Falls, Montana.

The United States Smelting, Refining and Mining Company. This company operates a 1000-ton mill at Midvale in connection with its lead smelter at that place.

As before stated, the greater part of the copper and lead-zinc ores which are mined in Utah are first concentrated for the purpose of removing as much

as possible of the barren gangue material. At the present time there is no zinc reduction plant in the Salt Lake Valley. However, the following companies operate copper and lead smelters on a large scale:

American Smelting and Refining Company. This company operates two smelters in the valley, namely a lead smelter at Murray, seven miles south of Salt Lake City, and a copper smelter at Garfield, seventeen miles west of Salt Lake City. This latter plant treats chiefly the copper concentrates from the mills of the Utah Copper Company nearby and produces more copper per day than any other smelter in the world.

The International Smelting Company operates a smelter at Tooele, forty miles southwest of Salt Lake City, at which are smelted both lead and copper ores.

United States Smelting, Refining and Mining Company has a lead smelter at Midvale, 12 miles south of Salt Lake City. In addition to its mill and smelter, the United States Company has an arsenic department where weed killer and insecticides are manufactured. This arsenic, of course, is derived from the silver-lead ores which carry it in small quantities.

Markets. Although there are excellent primary reduction plants in the Salt Lake Valley, no refineries have been established to finish the bullion produced by the lead and copper smelters. Central refineries located nearer the ultimate market for the finished metals have proved more economical for large companies operating smelters in Mexico, Canada, and South America as well as in the United States. The lead bullion of the United States Smelting, Refining and Mining Company and of the International Smelting Company goes to East Chicago, Indiana; that of the American Smelting and Refining Company is refined at Omaha, Nebraska. Raritan, N. J. and Baltimore, Maryland, are the destinations of the copper bullion produced by the International and American Smelting companies, respectively. Zinc concentrates from the various mills go into the electrolytic zinc made at the Anaconda Copper Mining Company's plant at Great Falls, Montana. In recent years, very little gold or silver bullion has been produced in Utah. The gold or silver contained in the original ore is not separated from the lead or copper by smelting, and is only recovered from the latter bullions by electrolytic refining.

Finished products. The chief finished products from Utah's mineral industry have been gold bullion from placer operations or the old bonanzas of Marysvale, Tooele County, and the other camps in their earlier periods of development, arsenic weed-killers from the lead smelters, cadmium from the Midvale smelter, mercury from the Mercur District, iron from the Columbia Steel Company, and the fuels and non-metallics, which are discussed further on in this book.

Iron Industry[1]

In the United States, local manufacturing in iron and steel products has always followed closely upon the development of iron ore deposits of sufficient quantity and quality to warrant its smelting, this in turn is dependent upon

[1] Iron Fields of the Iron Springs and Pinto Mining Districts, Iron County, Utah, by Duncan MacVichie. Transactions of American Institute of Mining and Metallurgical Engineers, No. 1468-I.

suitable coking coal adjacent to such deposits. Extensive deposits of phosphate rock, pure limestone, and high-grade manganese ore have also speeded the development of the iron industry.

For many years it has been known that Iron and Washington counties in Utah contained large iron ore deposits estimated by the United States Geological Survey at forty million tons, with other engineers estimating this at one hundred and sixty-four million tons of ore in sight with probabilities of there being up to one billion tons. Most of this hematite ore averages approximately 57% iron. In 1928, Utah ranked fifteenth among the iron-producing states, with a production of 165,702 tons of pig iron, 0.45 of 1% of the total output of the United States. General foundry work here and on the coast and the open-hearth steel plants of the Columbia Steel Company, located in California and Oregon, have been the chief consumers of pig iron. Local steel foundries have consumed only a small percentage of the total output.

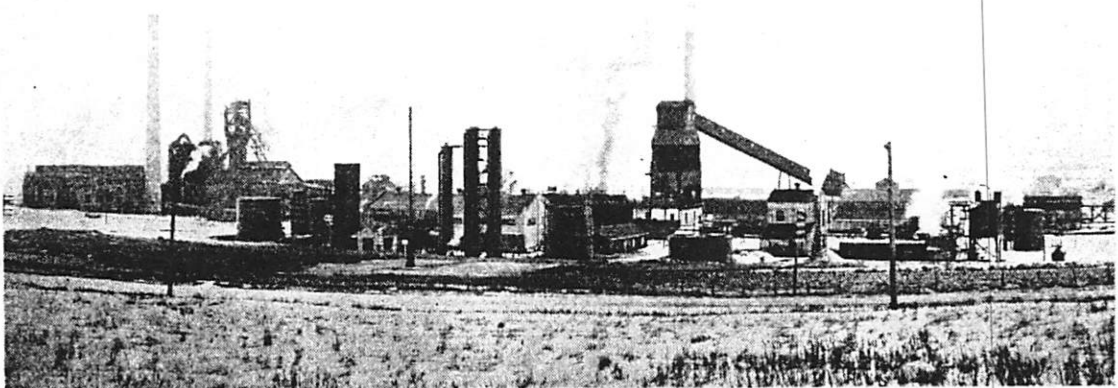


FIGURE 101—The steel plant at Ironton. The iron ore of Iron County and the coal of Carbon County are assembled at this plant in the manufacture of iron and steel.

In Carbon County, Utah, large deposits of coking coal were found suitable for blast furnace operations. For many years these deposits lay untouched. In 1922 the Columbia Steel Corporation, a Pacific Coast enterprise, purchased large holdings of iron and coal deposits and erected at Provo, Utah, a blast furnace and by-product coke ovens. From their inception these operations have been successful, and pig iron of superior quality has been produced. The capacity of this plant is approximately 150,000 tons of pig iron and 300,000 tons of coke annually.

At this same time the Republic Creosoting Company erected a plant to take the coal tar from the coke oven operations. In 1926 the Pacific States Cast Iron Pipe Company erected a plant adjacent to the blast furnace and since that time has made very rapid growth.

The yearly pay roll of these plants is about $1,500,000 giving employment to hundreds of persons.

In 1929 the United States Steel Corporation became interested in the Columbia Steel Corporation, and early in 1930 took over its entire holdings, including finishing plants in Pittsburgh, and Torrance, California and Portland,

Oregon. This development is of great importance to the entire Pacific Slope and, doubtless, large markets for finished products will be found in Russia and the Orient. Utah looks forward with confidence to that time, which now seems near at hand, when her iron and steel industries will be the basis for large industrial expansion.

Oil Possibilities

On account of the large mountain ranges traversing through the State of Utah consisting largely of the older rock formations and resulting, either on one side or the other, in what is termed a general depression of the beds without proper structural folding, and also a break-up of such possible folds in large gathering areas, Utah has not the numerous oil possibilities that such states as California, Texas, Oklahoma, and Kansas possess. However, there are some possibilities of oil discovery in commercial quantities still remaining. Oil has been found in limited quantities at Cisco, Utah. At present several wells are being drilled in locations where the objective beds are petroliferous and might permit proper trappings or reservoirs for oil. The main objectives in this area are the Pennsylvanian formations. If oil is to be found in commercial quantities, no doubt, the genesis of this production will be from the Pennsylvanian shales which produced so prolificly for a very short time from the Cane Creek Well, on the Colorado River, near Moab, Utah.

At Virgin, in southern Utah, there are quite a number of small wells on a monocline and the productive horizon is in the lower Moenkopi or the upper Kaibab formation. Therefore, east and southeast of this area there still remain certain possibilities for oil to be found in these same beds.

In the meantime, however, crude oil from the nearby Wyoming and New Mexico fields is brought to Salt Lake City for refining by the Utah Oil Refining Company. This activity already constitutes one of the foremost industries in the state, making Utah an important oil refining center. The plant is one of the most modern in the United States and furnishes employment to hundreds of Utah families.

Oil shale. Utah has extensive deposits of oil shale which will be developed and commercialized when justified by a suitable price for petroleum products. Before petroleum was discovered in Pennsylvania, oil had been distilled from shale in Juab County, where the ruins of an old still may yet be seen. Since 1859, there has been produced in United States about eighteen billion barrels of crude oil. It is conservatively estimated by the U. S. Geological Survey that oil shales of Utah will eventually produce sixty to eighty billion barrels of shale oil, with perhaps 750,000,000 tons of ammonium sulphate as a by-product.

The shale beds vary in thickness, ranging from only a few inches to over 100 feet, and occur in what is known as the Green River formation, which consists predominately of shale. The Green River formation extends south from Wyoming, crossing the Utah-Wyoming line about 210 miles west of the Utah-Colorado line, and extends into Utah for a distance of about 60 miles. The area is generally semicircular in shape, though irregular, and has a width of about 260 miles on the Utah-Wyoming line. However, the largest area of the Green River formation that is found in Utah lies in the Uintah Basin. It extends from the Utah-Colorado line at points that are roughly 100

miles north and south of Dragon, thence in a westerly direction to Soldier Summit and near Colton, whence it bends south and extends to a point some 20 miles southeast of Manti. A separate area, roughly elliptical in shape and measuring approximately 15 by 35 miles, is found some 20 miles west of Manti, but east of Juab, and extends north to within a few miles of Nephi. Though these areas are areas of the Green River formation they are not necessarily oil-bearing throughout their entire extent. Near Manti an area of some 2,500 square miles in reported to contain good oil shale of the type found in the Uintah Basin. These shales are said to contain a little over 40 gallons of oil per ton.

Cannel coal. A temporary competitor for oil shale may be found in Utah cannel coal. Excellent showings have been uncovered 25 miles southeast of Cedar Breaks. This cannel coal averages 75 gallons of oil per ton.

No doubt the public is aware that the Germans have, for several years, been operating a process known as "Hydrogenation." The new process is the most remarkable chemical engineering development known to the great oil scientists of the world. It is capable of taking heavy tars, residuums from crude oil, heavy sulphur crudes and even coal, and making high grade motor fuels and exceptionally high grade motor oils and other petroleum derivatives. Utah coal is especially adapted to this process. Those who have carefully studied the subject venture to prognosticate that within ten years this process will be established on a large scale in Utah and that it will result in the greatest industry within the state. The enormous possibilities are readily apparent.

Coal Industry

Historical. Although coal has been mined in Utah since the early pioneer days, the coal industry of the state is still in its infancy. With approximately one-sixth of the area of the state underlain with beds of coal of workable thickness, the United States Geological Survey estimates the unmined reserve at 196 billion tons. While the deposits in the vicinity of Coalville, Summit County, probably were the first developed in a commercial way, the major development has occurred in the Carbon-Emery District, in the central part of the state, and from this area approximately 98 per cent of the coal is mined at present.

At this time, beds under four feet thick are not considered commercial and approximately 70 per cent of the coal now produced is coming from beds ranging from eight to seventeen feet thick. The average annual production during the past ten years is about 5,000,000 tons. About half a million tons a year are converted into coke and the remainder goes on the commercial and industrial markets of Utah, Nevada, California, Idaho, Montana, Washington, and Oregon, with small shipments eastward into Colorado, Kansas, and Nebraska. About one-third of the total production is exported.

Classes of coal. Utah's coal reserves, like those of the other Rocky Mountain States, can be divided into two general classes, Cretaceous and Tertiary.

Utah's Tertiary coals are of less importance and are chiefly sub-bituminous

in inherent quality and in addition are banded with dirt and slate. Because of the abundance of higher grade coal, the Tertiary fields have been developed only to supply needs of a very local nature.

The coals of the Cretaceous were laid down in the empirical (Cretaceous) sea and represent ages of vegetable growth around the margins of this sea.

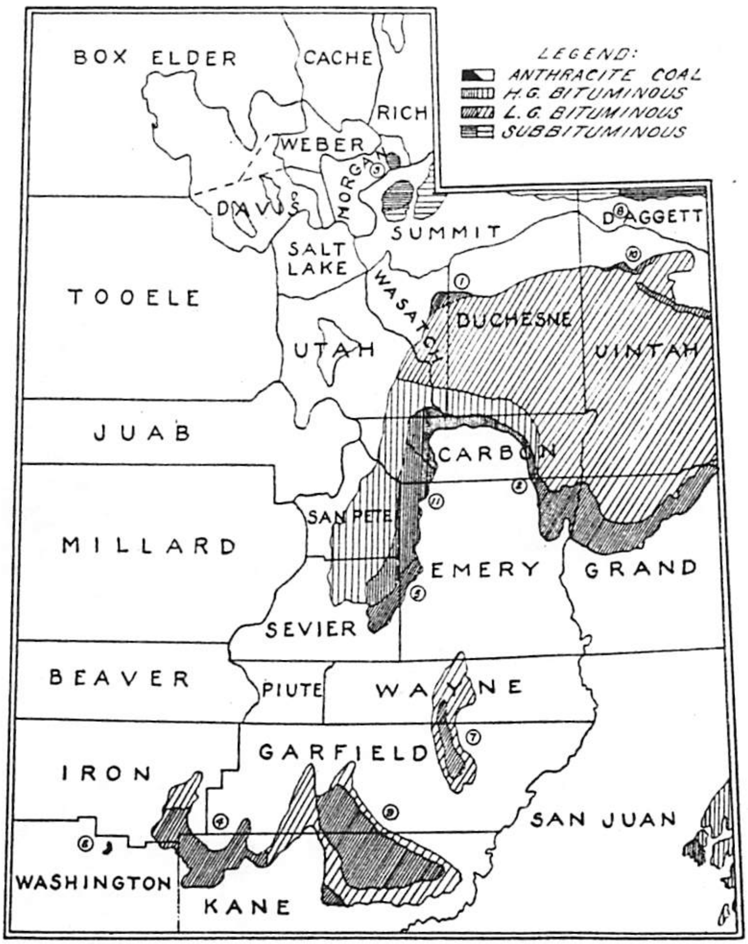


FIGURE 102—Map showing the coal fields of Utah.

1. Blacktail Mt.
2. Book Cliffs
3. Coalville
4. Colob-Kanab
5. Emery
6. Harmony
7. Henry Mt.
8. Henry's Fork
9. Kaiparowits
10. Vernal
11. Wasatch Plateau

In addition to the vertical pressure provided by the weight of the succeeding strata, this coal was subjected to the lateral pressure developed during the elevation and folding of the Rocky Mountains. Since the extent of the dynamochemical changes to which a coal is subjected largely governs its character, it is not surprising that our Carbon-Emery County Mesa Verde Coals are an excellent grade of bituminous. They are considered the highest quality bituminous coals on the western market, are low in ash and moisture, extremely low in sulphur, and have a heat value of about 13,000 b. t. u.'s (British Thermal Unit). Physically, they are hard, do not slack readily, and range from very blocky to friable in structure. The coals are high-volatile and, with a few exceptions, non-coking.

The big majority of the coal production of Utah comes from the mines developed in the Mesa Verde coal of Carbon and Emery counties in the east central part of the state as shown by deposit No. 11 in Figure 102.

The coals in the fields in the vicinity of Sunnyside can be made into a good grade of coke. At this point the Utah Fuel Company has a battery of about 800 beehive coke ovens each with a six-ton capacity. In addition to these operations the Columbia Steel Company operates by-product ovens in connection with its blast furnaces at Ironton, near Provo.

The average value of the coal at the mines in recent years, on a run of

mine basis, ranges from about \$2.50 to \$2.75 per ton, making the average annual production value about \$12,500,000 to \$14,000,000.

The average number of employees in the coal industry is a little in excess of 5,000, and the annual payroll is about \$7,500,000 although the industry furnishes the chief means of livelihood for approximately 25,000 men, women, and children in the State of Utah. In addition to the wages paid, the coal industry spends in the neighborhood of \$2,500,000 annually for supplies, \$750,000 for power and taxes, and provides about \$15,000,000 a year in freight revenue for western railroads.

Courtesy Liberty Fuel Company.

FIGURE 103—An electric undercutting machine. This machine undercuts the coal so that it will break properly when blasted with powder.

Generally, the mines are exceptionally well equipped. The installed tipple capacity is in excess of 14,000,000 tons per year, figuring 300 eight-hour working days. The average working period is about 200 days per year.

The Carbon-Emery Region is served by two railroads—the Denver & Rio Grande Western and the Utah Railway, and the Coalville District is served by the Union Pacific Railroad.

NON-METALLICS[1]

A complete survey of Utah's non-metallic resources has not yet been made, but it is known that the state possesses great undeveloped deposits of non-metallic substances which await the establishment of new industries to effect their exploitation.

Utah's known resources of non-metallics, though in the primary stage of development, constitute several industries that are contributing materially

[1] Utah has a greater variety of raw materials for manufacturing than any other state in the Union, and has a greater variety of minerals than any similar area in the world.

to the importance of the mining industry and the resources possess the basic requirements for practically unlimited expansion in the future as population and manufacturing in the west increase.

At the present time, the established industries are as follows:

Salt. Vast deposits of salt exist in Utah. Rock salt is mined from open-cuts in Sevier and Sanpete counties, but the principal production originates from the waters of the Great Salt Lake. This inland sea has an area or 2,250 square miles, being about 75 miles long and 30 miles wide.

All evaporated salt is made by what is known as the Solar Process—the sun does the work. The water from the Great Salt Lake, the contents of which range from 13% to 18% salt, is lifted several feet to a level where it then flows by gravity into large concentrating ponds of several thousand acres. The water is allowed to remain in these large ponds for several weeks, until the brine begins to concentrate. Before the salt begins to precipitate, the brine is conducted by gravity into the "solar vats." These vats are large earthern ponds some 25 acres in extent. The bottoms of the "solar vats" are pure salt, having been deposited in previous years. The salt brine is allowed to remain in these vats during the summer, until much of the salt has precipitated. The remaining brine, or liquor, is drawn off quickly, before the undesirable solids which are in the original lake water are allowed to precipitate—the liquor being diverted back into the Great Salt Lake. This leaves a deposit several inches in thickness averaging over 99½% pure salt. This deposit remains in the ponds to dry until about the first of September, when the "salt harvest" begins. The salt deposit is then loosened up by plows drawn by tractors. Mechanical salt harvesting machines, drawn by tractors, are taken into the ponds and the salt is piled in long piles near the railroad track where it is allowed to "cure" during the summer. It is then loaded into trams and taken into the salt mill, where it is passed through enormous driers. It is then run through the crushers, rolls, screens and automatic weighing machines, during which process it is made into the desired grade of salt for every possible purpose to which salt may be applied.

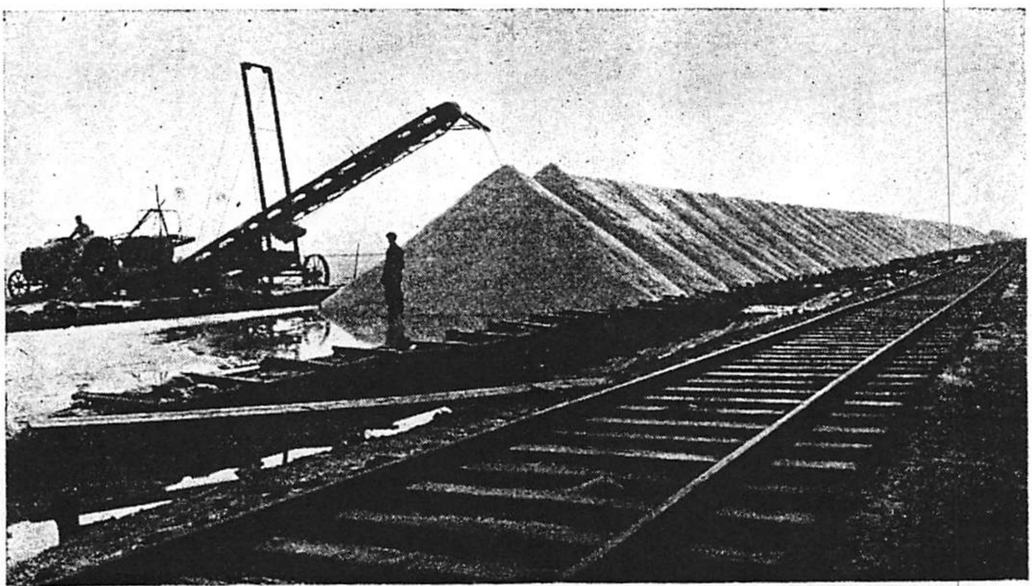


FIGURE 104—A salt mining plant near the shores of Great Salt Lake.

The salt production thus carried on in Utah amounts to approximately 80,000 tons annually, and has a value of about $400,000.

Other salines. The utilization of the salines of the Great Salt Lake and of the Great Salt Desert in Western Utah, other than salt, as for example calcium, magnesium, and potassium is a potential industry of the future. The Great Salt Lake Desert is one of the largest areas of potash-bearing salts in the United States. The salts are present in the strong brine solutions in the form of potassium chloride in quantities averaging about 7 per cent, or 3.5 per cent potassium. This is about twice the concentration of the potash salts in the waters of Great Salt Lake. Brines are found in both the salt crusts and underlying mud; the solutions obtained from the mud at depths show over 25 per cent dissolved salts of which 3 to 4 per cent is potassium.

Magnesium chloride is present in slightly less quantities than potassium chloride and no doubt will be equally as valuable as the potash content if research in the production of magnesia metal proves true.

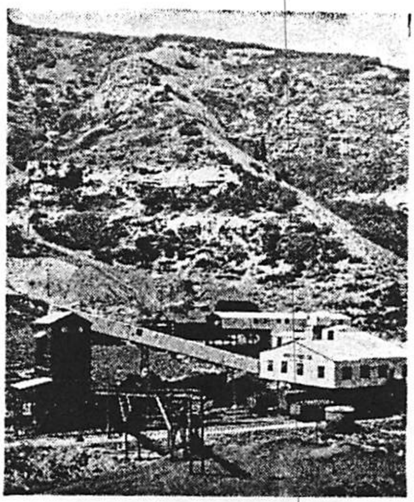


FIGURE 105—A tipple for screening cleaning, sizing and loading coal.

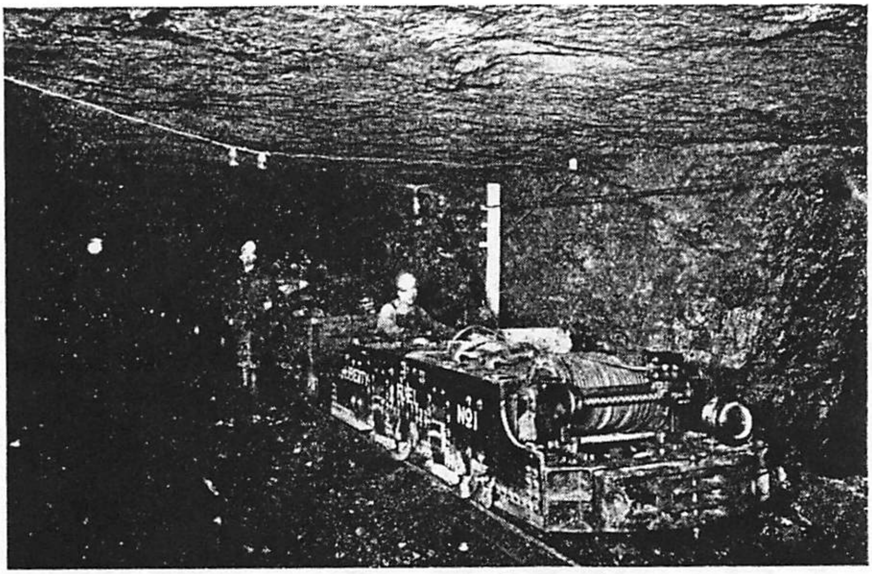
Hydrocarbons. The Uintah Basin contains the largest deposits of asphalt and related bitumens found in America. In this region are found gilsonite, elaterite, sometimes called "Uintahite," and ozoherite. The only other places in which these rare minerals exist in large quantities, so far as is known, are Galacia, Roumania, and Baku. These bitumens, resembling tar, except that they possess a greater gloss and hardness when cold, are residues of petroleum and have important uses in the manufacture of high class varnishes, japans, insulation, mineral rubber, acid proof paints, and waterproofing compounds.

Origin. In origin these bitumens are closely associated with the oil shales of the Uintah Basin, discussed in a previous section. Although called "oil shale," the shale does not contain oil as such, but a solid carboniferous material called kerogen which, when subjected to intense heat or to the energy of rock flowage, is converted into petroleum. In the Uintah Basin portion of the Green River formation, one of the above mentioned factors, probably the latter, acted to release a large quantity of petroleum. In the absence of a suitable collecting structure the oil escaped into fissures in the overlying rock or into porous sandstones. Here the more volatile constituents evaporated, leaving the solid residues which are mined today.

Gilsonite is found in veins from a few inches to eighteen feet wide. Near Watson, the Gilson Asphaltum Company has mined one vein, the Rainbow, for three miles in length and to a depth of more than 400 feet in places. Select gilsonite is found at a distance of about 70 feet below the surface.

Elaterite is found in both Carbon and Wasatch counties, in the vicinity of Strawberry Creek, in veins ranging from one to twenty inches wide. The ore is sacked and hauled to the railroad for shipment to refineries.

Ozokerite has been mined from an area in Central Utah twelve miles long and one to four miles wide, near the towns of Colton and Soldier Summit. This mineral also occurs in irregular vein deposits in fissures and crushed zones in limestone, shale, and sandstone.



Courtesy Liberty Fuel Company.
FIGGURE 106—Electric gathering locomotive, used for gathering loaded mine cars from the workings.

Asphaltic limestone and bituminous sandstone exist in large quantities and are valuable for their asphaltic content and also as a natural paving material. This production has been only about 10,000 tons per year, which is small in relation to the almost unlimited reserve.

The following table of production is for the year 1929, and shows a healthy increase over that for 1928:

	Short Tons	Total Value	Av. Value Ton
Gilsonite	54,987	$1,235,920	$ 22.50
Ozokerite	290	133,400	460.00
Wurtzilite (Elaterite)	200	30,000	150.00
Bituminous Rock	10,064	80,512	8.00
TOTAL	65,541	1,479,832	-------

Sulphur. The largest sulphur deposit in the state is that known at the Cover Creek beds at Morrissey, about 20 miles north of Beaver. These deposits were owned and operated for years by the "Mormon" Church, but have since passed into the control of private enterprise. The holdings of the present owners comprise about 640 acres of sulphur-bearing land which varies slightly in sulphur content. This deposit has been worked intermittently for more than forty years and is capable of producing sulphur on a fairly large scale under favorable conditions.

Another sulphur deposit is known in San Rafael Canyon and has been described by the U. S. Geological Survey. This deposit is as yet undeveloped.

Gypsum. Large deposits of gypsum occur in several localities in the south-central part of Utah. Not all of these deposits are within reach of transportation facilities at the present time; some of them stand untouched as yet and will supply the needs of generations to come.

About 45,000 tons of gypsum are mined yearly and this output is valued slightly less than $300,000. A large part of this product is used in the manufacture of plaster.

Lime. The lime industry of Utah is becoming more and more important and is fast growing. Since 1925 the lime production of the state has more than doubled, until at the present time about 45,000 tons are produced per year with a value of approximately $375,000.

Sand and gravel. Utah's sand and gravel production is of considerable importance to the state. While the output of sand and gravel naturally varies considerably with building and construction conditions, the average annual output for Utah is almost 1,000,000 tons, with an approximate value of $275,000.

Cement materials. There is an abundance of raw material in Utah for the manufacture of cement. Limestones low in magnesium carbonate are found in many parts of the Wasatch Mountains. Many of them are below 75 per cent in lime carbonate and approach in composition the cement rock of the Lehigh District of Pennsylvania. The purer limestones necessary to give them the proper percentage of lime for a Portland cement mixture are also abundant. Under such conditions the chief factor governing the value of a deposit is the distance to the ultimate market. The low unit value of such heavy structural materials will seldom permit profitable long distance exportation.

Two different types of limestone are mined, one a cement rock high in clayey matter, the other a relatively pure limestone. Limestone and shale mixed in the proper proportions constitute the raw materials for the manufacture of cement.

At Baker, north of Brigham City, there is a deposit of marl from four to ten feet in thickness underlain by a bed of clay that has been tested to a depth of 18 feet. A proper combination of the two, when heat treated, makes an excellent Portland cement.

Clay deposits. Utah is favored with a number of deposits of natural clays which are suitable for the manufacture of brick, tile, and other products. These deposits have a bewildering variety of colors, shades, and textures. Few localities compare with our state in this respect. These deposits are distributed quite universally in the several counties and contribute to one of the large industries of the state.

There are also large deposits of quartzite beds suitable for use in the manufacture of plate and window glass as well as cheaper products. Since many of the other constituents of glass can also be found in Utah, the establishment of a fabricating plant should be an event of the near future.

Helium and carbon dioxide. In a deep test well driven on the subsidiary Woodside anticline of the Utah Oil Refining Company, gas was struck in a sandstone at 3,150 feet, probably in the upper beds of the Coconino sandstone. The well commenced at the top of the Curtis formation and was 3,270 feet

deep when closed in. Tests showed the gas to be non-combustible, chiefly carbon monoxide, containing notable quantities of helium. Accordingly, the entire area included within the closing contour of the anticline and a protective strip without it was set aside as Helium Reserve No. 1, by executive order of March 21, 1924. The boundaries were modified on January 28, 1926. No further development has taken place, the reserve being established for national emergencies.

Similar quells containing no helium, but analyzing over 99% carbon dioxide, have been drilled in the same district. These are being made the basis for new industries which require a cheap source of sulphur-free carbon dioxide.

Radium, uranium and vanadium. Radio-active ores bearing these metals are found in Grand, San Juan, Emery, and Wayne counties. The manner of carnotite occurrence is of unusual interest. The richest deposits are found in the form of petrified trees or bones, which occur in the coarse, loosely-consolidated sandstone. The cornotite and vanadium minerals also impregnate the sandstone and coat the faces of joints. Mining of radium and uranium ores in Utah, however, has been greatly reduced by the drop in the price of radium resulting from the discovery of the great deposits in the Belgian Congo, Africa.

This does not apply to vanadium mining, which has only recently been made an established industry by the construction of a refinery near the site of the deposits. A test mill in the Dry Valley District, 16 miles northwest of Monticello, proved so successful that a much larger plant has been built. The finished product is vanadium oxide, the acid anhydride.

Potash.[1] Three vast sources of potash exist in Utah: The brine of Great Salt Lake, the Marysvale alunite deposits, and potash mineral, carnellite, discovered in drilling the Crescent Eagle well near Thompson.

Potash from alunite.[2] Utah contains the biggest deposits of high-grade alunite in the United States. These deposits are located near Marysvale in Piute County in the Tushar Range of mountains which have an elevation of 10,500 feet.

Before the war the possibilities of producing potash from this material were realized and during the war several large and expensive plants were installed, among them being the Amour Fertilizer Corporation, the Mineral Products Corporation, and the Aluminum Potash Corporation.

The potash content of the alunite is about 11.5 per cent potassium oxide, 35 per cent aluminum oxide, 3.5 per cent silica, 38 per cent sulphur trioxide, and 12 per cent water of crystallization. The alunite requires calcining to render its potash content water soluble, and after leaching the product obtained is sulphate of potash, (K_2SO_4), a very desirable fertilizer which, when pure, demands a premium price in the markets.

After the war the plants were shut down, not because of the failure of the processes, but on account of the extremely high freight rates to eastern and southern states where the comsumption of fertilizers is the greatest. The

1 Potash in 1924, by G. R. Mansfield and L. Boardman, Bureau of Mines, Mineral Resources of the United States, Part 11-6.
2 Alunite near Marysvale, Utah, by B. S. Butler and H. S. Gale, U. S. G. S. Bulletin No. 511.

alunite deposits of Utah constitute a valuable asset, the future of which development as a source of domestic fertilizer supply awaits the demands of agriculture.

Potash from waste. Not only is it possible to obtain fertilizers from the sources above mentioned, but also from the mill tailings. For example, tailings from the Utah Copper Company are finely ground and delivered to the dumps near the Great Salt Lake at the rate of 40,000 tons per day. They contain about 6.5 per cent of potash. Investigations leading to the recovery of this potash content are being carried on.

Other non-metallics. Other non-metallics which occur in the state, deposits of which are of sufficient size and importance to permit of their being developed commercially, are phosphate rocks, sodium sulphate, clays, sands, marble, diatomaceous earth, antimony, arsenic bentonitic clays, and slate. At the present time the Industrial Department of the Salt Lake City Chamber of Commerce, the Utah Industrial Development Association, and the Department of Mining and Metallurgical Research of the Utah Engineering Experiment Station of the University of Utah, are cooperating in gathering all possible information concerning the non-metallic resources of the state and likewise in securing representative samples of these non-metallics. In connection with this work the Engineering Experiment Station of the University of Utah has formulated plans and is ready to proceed, as soon as the necessary funds are available with a mineral survey which will have for its object obtaining of exact information as regards the location and composition of all deposits, concerning which, information is now being collected by the organization above mentioned.

Graduate instruction in mining and metallurgy. A distinctive feature of the Engineering Experiment Station of the University of Utah is its Department of Mining and Metallurgical Research.

The solution in the future, of the problems concerning the mining and metallurgical industry will depend upon industrial research, based upon fundamental research. In other words, the industries, including mining and allied industries, which of course include the metallurgical industry, must depend upon the scientists of our colleges and universities and upon the scientific bureaus of the Government, such as the Bureau of Mines, to furnish the fundamental data the industries need in devising new processes or for increasing the efficiency of existing ones. This is essentially true of the mining industry and particularly in metallurgy.

The Department of Mining and Metallurgical Research of the University of Utah was established because of this fact, and it has striven ever since its inception in 1913 to render that service to the mining industry which will permit of its becoming more efficient in its mining and metallurgical operations and which will broaden the scope of its usefulness.

Each year a number of fellowships are awarded to college graduates who have had the necessary training in mathematics, physics, and chemistry, as well as in mining, metallurgy, or geology, depending on the investigation which is to be pursued. Since the establishing of the department in 1913, a total of 115 fellowships have been awarded by the department. The holders of these fellowships have come from 30 or more universities and colleges.

United States Bureau of Mines. Utah is particularly fortunate in having a Mining Experiment Station located on the campus of its State University in cooperation with the intermountain station of the U. S. Bureau of Mines. In addition to the cooperation which the bureau carries on with the University, it also maintains economic and health and safety sections at its intermountain station. The work of the economic section has to do with the gathering of statistics in the western states concerning the production of the metals and non-metallics.

During 1928, in recognition of Utah's importance as a mining center, the bureau established a health and safety station at the intermountain station, thus making it one of the ten safety stations which the bureau has established throughout the country. The station in Salt Lake City is especially well-equipped for emergency rescue work, in case of mine disaster and for training in first aid.

Salt Lake City is the greatest non-ferrous smelting center in the world. Ores from nearly a dozen states are shipped to the smelters in this vicinity.

TABLE 67

UTAH'S PRODUCTION OF NON-FERROUS METALS—1860-1929

	Gross Value	Dividends
Alta Ore Zone (No 1929 data)	$ 37,811,015	$ 3,019,048
Beaver County (No 1929 data)	54,867,108	7,865,104
Bingham	916,547,679	219,452,693
Park City	280,582,999	63,083,435
Tintic	324,750,864	51,968,619
Tooele (No 1929 data)	67,079,826	5,160,823
Miscellaneous (No 1929 data)	23,969,856	3,034,023
TOTAL	$1,706,999,947	$353,601,272

Mining as an industry. Mining has been an important industry in the state for more than two generations and in recent years Utah has taken a place among the five leading states of the nation in the output of gold, silver, copper, lead, and zinc. In 1929 Utah led all the states in the production of silver and was second in the production of zinc and lead, and fourth in the production of gold. As has been observed coal, iron, hydrocarbons, sulphur, salt and numerous other metallic and non-metallic materials are produced in large quantities. In fact, Utah's enormous stores of non-metallic materials have scarcely been touched. It is interesting in this connection to note that the national production of non-metallics is of greater economic importance than is the production of metals.

Utah is richly endowed with non-metallic resources, having a greater variety of such resources than any other state in the union and possibly a greater variety of mineral resources than any similar area known. The one unfortunate circumstance is that we have been content to market our wares in a large measure in the raw or semi-processed state. We ship our copper out of the state as crude ingots, our zinc in the form of concentrates and our lead in an unrefined condition, leaving it to others to refine and fabricate the products and to

TABLE 68
Metal Production of Utah's Leading Camps
(1929 Summary)

Camp	Tons (Ore)	Gold (Ounces)	Silver (Ounces)	Copper	Lead	Zinc	Value	Dividends
Bingham	18,600,000	160,410	4,640,000	311,900,000	96,600,000	43,600,000	$70,647,228	$32,847,600
Park City	743,000	21,800	6,420,000	3,000,000	84,700,000	53,150,000	13,328,850	3,007,331
Tintic	420,000	42,000	6,130,000	2,800,000	85,600,000	750,000	10,128,311	2,294,859

TABLE 69
Non-Ferrous Metal Production of Utah—1918-1932
(From Reports of U. S. Bureau of Mines)

Year	Tonnage	Gold (Dollars)	Silver (Ounces)	Copper (Pounds)	Lead (Pounds)	Zinc (Pounds)	Value (Dollars)	Dividends (Dollars)
1918	14,705,718	$ 2,949,170	13,455,597	277,169,630	167,008,224	18,399,417	$86,047,597	$19,301,274
1919	6,745,423	2,159,471	11,649,961	124,061,807	123,829,051	4,431,023	45,169,328	11,994,766
1920	6,800,180	2,014,556	13,106,976	116,931,328	140,838,113	8,157,739	49,744,334	11,790,133
1921	2,137,522	1,769,905	12,251,998	30,891,403	89,187,269	69,390	22,023,790	4,840,167
1922	5,560,034	2,296,855	17,271,100	97,193,850	135,332,144	5,119,410	40,424,199	5,004,460
1923	12,752,998	3,076,213	19,137,470	222,393,572	203,447,793	11,330,913	66,472,911	10,007,106
1924	13,640,618	3,028,129	17,253,692	242,138,165	233,910,875	18,562,172	66,227,637	9,979,635
1925	14,479,247	3,675,543	21,276,689	236,486,540	306,669,824	52,611,732	82,701,394	12,690,210
1926	15,856,144	3,778,046	19,358,581	257,464,482	295,270,025	95,179,380	82,662,884	15,073,464
1927	15,757,074	4,008,453	18,606,950	256,933,278	302,570,040	99,185,443	73,626,632	15,463,017
1928	18,427,117	4,393,993	17,072,852	293,235,039	291,830,021	93,857,352	79,258,904	18,077,191
1929	19,831,975	4,969,915	17,592,396	318,282,523	298,754,429	103,019,485	95,985,201	38,167,339
1930	11,041,841	4,309,148	13,129,421	180,526,423	230,989,780	88,990,938	48,653,464	19,165,125
1931	8,954,617	4,108,323	8,290,966	151,236,505	158,423,453	74,581,072	28,970,974	10,571,287
1932*	3,776,800	2,946,832	6,979,500	65,906,000	122,487,000	58,150,000	14,167,603	410,613

*Preliminary

receive the benefit of the additional labor, power and materials required in the processing. We even buy back some of the finished products made from our metals and see still others pass on their way to the Pacific Coast, to the Orient or to the islands of the sea. Surely the time has come for us to apply vision and intelligence in the proper utilization of our resources and thereby realize on our inheritance.

Growth of the industry. The future growth and material development of Utah must be based in a large measure on the refining, processing, and fabrication of the minerals produced in the state. The state must stimulate the exploitation of her non-metallic resources and encourage the introduction of extensive chemical industries. Such development is not only possible but is economically feasible, provided advantage is taken of natural conditions through a well planned and intelligent program of cooperation.

In the mining, milling and smelting of our non-ferrous, metallic ores, some thirteen thousand persons normally are employed directly. In the mining, milling and smelting, refining and fabrication of the five chief non-ferrous metals produced in the United States, some three hundred thousand persons are employed directly. Utah produced one-seventh of the national output of such metals and should she undertake to refine and fabricate, as well as mine, mill, and smelt, she would require more than forty thousand direct workers, instead of the thirteen thousand now employed.

An expanded industrial development would enlarge transportation requirements, increase the demand for agricultural products, require the services of more professional men, increase the wholesale and retail business and extend banking, building construction, and manufacturing. In a word the state would grow in population, wealth, and income.

There are two primary requisities to industrial development, namely, an ample supply of water for industrial purposes, and a large supply of electrical energy at extremely low unit cost. The development of the electrical energy, in turn, under the conditions prevailing in Utah, calls for an enormous supply of water. Future development of the state then finally resolves itself into the necessity of providing an additional supply of water.

New projects. Most of the available sources of water have long since been appropriated with the exception of the water in the Great Salt Lake. Unfortunately, the brine in Great Salt Lake renders the water unsuitable for power or irrigation purposes. The supply of water to the lake from the rivers, however, is suitable for both purposes and out of this fact has grown the proposal to dike off that portion of Great Salt Lake lying east of the chain of islands, thus forming a fresh water reservoir.

The forming of this fresh water reservoir would require the construction of dikes, spillways, and sluiceways to expedite the freshening of the impounded water by the flow from Bear, Jordan, and Weber rivers. The dyking of Great Salt Lake, after a period of a few years, would provide a large body of fresh water which could be used for generating electricity. The proposed diking project is of world-wide interest. It presents features that intrigue the scientist, the engineer, and the layman. It is one of many projects that offer an opportunity for the economic salvation of our commonwealth. Furthermore, it represents an inspiring example of the truism that what the mind of man can conceive, the hand of man can accomplish.

CHAPTER XVIII

MANUFACTURING

Utah is becoming more and more a commercial and industrial center. The growth of population on the West Coast and the inexhaustible supply of mineral products and raw materials have greatly stimulated manufacturing. There are at the present time nearly 750 manufacturing establishments of various types in the state. Nearly every standard industry is represented and signs of expansion are to be observed everywhere. Products of Utah factories find their way into the markets of most of our western states.

Manufacturing is the largest industry in the state. The value of the products of manufacturing for 1929 was $214,628,855.

EARLY HISTORY

Primary needs. In any pioneer community far from the centers of population the first manufacturing enterprises will usually be concerned with the production of the three fundamental necessities of life—clothing, food, and shelter. In this respect Utah was no exception. The first manufacturing establishments built by the pioneers, other than those carried on by individuals in their homes, were saw mills for the making of lumber, grist mills for making of flour, and woolen and cotton mills for the making of clothing.

Saw mills. The pioneers had brought with them some provisions, especially clothing and tools with which to work. Their first need, therefore, was lumber to build houses. Obviously the first houses were only temporary shelters to be discarded as soon as time and means would permit. The earliest of these were log cabins and houses made of sun-dried brick or adobes. As soon as the pioneers began to desire more substantial houses, it was necessary to develop saw mills and planing mills. Accordingly, the first manufacturing plant was a saw mill. The saw mill, tradition says, was located in Bingham Canyon and began operations in the latter part of 1847 or the early part of 1848. In the latter year two saw mills were built on a stream called Mill Creek, a name given it probably because of these mills. The stream is south and east of Salt Lake City. As the people spread out and settled in other parts of the state, they invariably built saw mills to provide the lumber needed to build houses, barns, and granaries.

Grist mills. Mill irons, millstones, and other accessories for grinding grain were brought across the plains by the pioneers of 1848. A man named Chrismon erected the first grist mill on City Creek. It was a crude affair, but it supplied a pressing need, for the grain crop of 1848 was fairly good and the people were happy to have it ground into flour. A few years later a more pretentious mill was erected. By 1852 there were several grist and saw mills in operation in Salt Lake Valley, Utah Valley, and Weber Valley. Having provided for their immediate food and shelter needs, the next problem was to provide materials for clothing. Sheep had been brought to the valley by the first colonists. Very soon the cultivation of flax and cotton was begun.